Interim Report of the Taxonomic Researches toward the Collembolan Family Cyphoderidae

AUTHOR(S):

YOSHII, Ryozo

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Interim Report of the Taxonomic Researches toward the Collembolan Family Cyphoderidae

Ryozo Yoshii

ABSTRACT A taxonomic research is made on the collembolan family Cyphoderidae, based on the material from diverse sources. In all, 15 species are treated, of which two are described as new to science. Discussions are made on key characters of the family, with a preliminary key to the genera given.

KEY WORDS Collembola/ Cyphoderidae/ taxonomy

The following results are quite diverse, some of them are in such an incomplete state only as to assist the identification of later works, while some others are more comprehensive. Since the final scope of establishing a new intelligible system of the family is still far from the present state, it is intended to publish what is already made, so that it may be continued further on, may it be by myself or by some other researchers.

The source of the materials are also very diverse, some of them are from the collection of my own from various places of Asia, others are from the collection of the National Museum of Natural History of Paris, deposited there by late J. R. Denis and Cl. Delamare Deboutteville, to which some of Prof. P. Cassagnau and others are added. This collection constitutes three boxes of microscopic slides and 3 bottles of alcoholic specimens. In this report only the former has been used, checked one by one with the aid of phase contrast microscope. For this exceptional facility I owe greatly to the kindness of the Paris Museum, above all of the colleague, J. M. Thibaud and J. Najt to occupy the working facilities for long time. The third source is due to Prof. G. H. Murphy of Singapore, in whose laboratory I have stayed for long time in collaboration and also in the field work. Lastly, one species of special interest I owe to Prof. T. Inoue of the Kyoto University, whose research in Panama has brought a precious specimen of a collembola commensal to stingless bees. Thus, to all the colleagues mentioned and not especially mentioned, but who have supported my works in various ways, as well as to the financial aid of the Toyota Foundation, I must thank with all my heart.

Cyphoderus cf. *albinus* Nicolet Fig. 1 A, B

FRANCE: Brunoy (1 slide, 20. VII 1979, Ponge leg.)

The example coincides well with my description of *C. albinus* in 1990 in various respects, but unguis is with a prominent dorsal tunica (Fig. 1 A) and ventral tube has 4 + 4 barbed setae on its anterior side. All setae of the posterior side seems to be finely ciliated, but their arrangement is just the same with *C. albinus*. Lateral flap bears 2 + 2 setulae.

Presence of such a form from around Paris implies the necessity of investigating the *albinus* group of Europe once again. As already cited in Delamare 1948, it may constitute a "Formenkreis" of its own. The species seems to have relation with *Cyphoderus paralbinus* Jacquemart, 1980.

***Cyphoderus javanus* Börner**

Cyphoderus javanus: Börner 1906, 1913 Yayuk et Yoshii 1989
Cy. borneensis: Yoshii 1980, 1987 Yayuk et Yoshii 1989

JAVA: Bogor (many ex. 3-10. II 1988); BORNEO: Batu Puteh Cave (5 ex. 12. VII 1985), Keningau (2 ex. 21. II 1985); SINGAPORE: Mandai Kecil (3 ex. 15. V 1987); PHILIPPINES: Los Banos (1 ex. no. 151, Gapud leg.)

Cyphoderus with bidentate mucro has been found in large numbers from the termite nest in the rotting bamboo rod on the ground in the Bogor Botanical Garden. They have been proved to be identical with *C. borneensis* Ys. in all details including buccal apparatus, clypeal setae, frontal setae, ventral tube and dental setae etc. The species seems to be

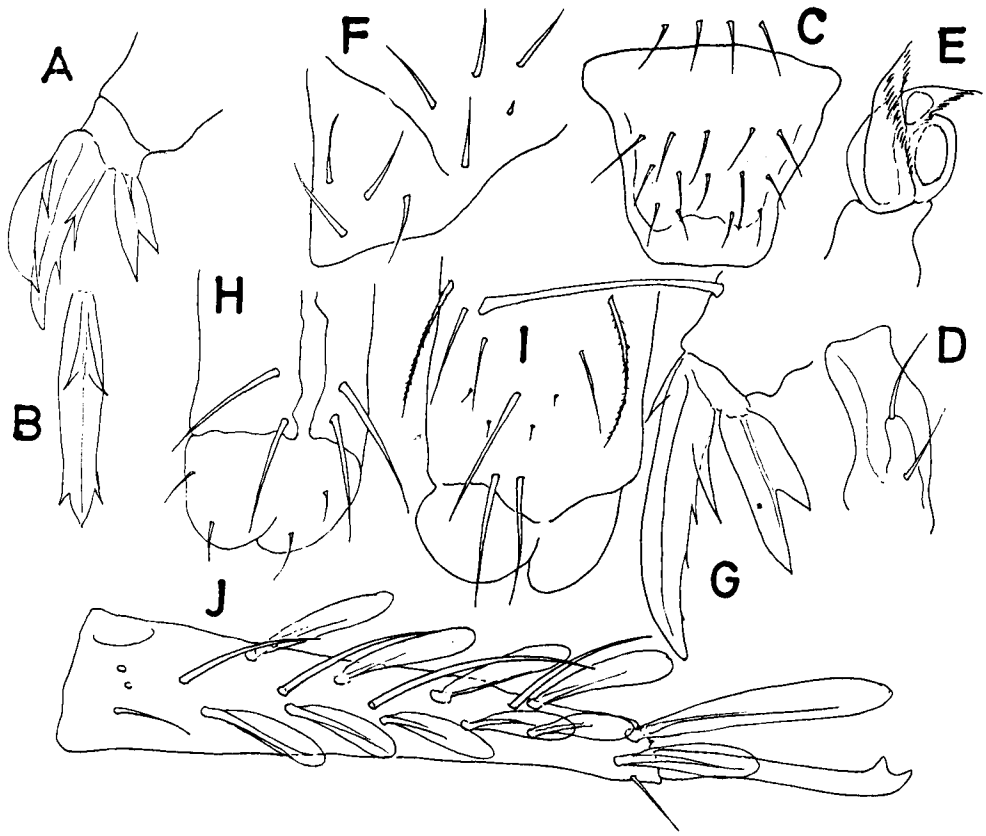

Fig. 1. *Cyphoderus* cf. *albinus* Nicolet from Brunoy, Paris.
A: hind tarsus, B: inner view of unguis
Cyphoderus cf. *handschini* Delamare from Borneo.
C: labrum, D: outer max. lobe, E: maxillar head, F: labial basis, G: hind tarsus, H, I: ventral tube (ant. & post.), J: dens & mucro.

widely distributed in Southeast Asia, but the report from India (Yoshii 1966) is decidedly different having smooth dorsal setae of dens.

Cyphoderus cf. *handschini* Delamare Fig. 1 C–G

C. handschini: Delamare 1948

BORNEO: Sepilok (2 ex. 26. V 1961); MALAYA: Negri Sembilan, Pasoh (4 ex. 11. VI 1986)

This is the book species of Delamare, based on Folsom's description of *C. assimilis* Börner from Hawaii, by which the presence of the tunica dorsally on unguis was the key character. He has also cited handschin's *C. assimilis* from Java with some doubt. In our examples, the dorsal setae of dens are all smooth (Fig. 1 J) and different from *C. javanus* in this respect Setae of ventral tube (Fig. 1 H, I) are all smooth except for one pair of the lateral group. To name it as separate species is quite easy, but the full diagnosis of the real *C. handschini* from Hawaii must be cleared before that.

Cyphoderus omoensis Delamare Fig. 2 A–I

Cyphoderus omoensis: Delamare 1945, 1948

ANGOLA: (4 slides, date ?, Delamare det.)

The species is already well described, for which following characters may be added. Labrum (Fig. 2 A) with setae 4/5, 5, 4, all smooth, margin without structures. Outer max. lobe (Fig. 2 B) with setae 2/II + 2, maxillar head not modified. Labial basis (Fig. 2 C) with setae mmre/l(l), so that r is not reduced and m-2 is larger than others. Clypeal area (Fig. 2 D) without extra setae, prefrontal and other pair are barbed. while 2 + 2 lateral setae are smooth. From the frontal area F-0 is a round vestige, f-1 to f-5 are all barbed and equally large. Ventral tube (Fig. 2 F) is anteriorly only with 2 + 2 large, barbed setae. Posterior side (Fig. 2 G) is with 1 + 1 smooth distal, and possibly one another smooth pair proximally. Lateral group is composed of 7-8 all barbed setae to each side. Small sensillar rods are possibly present but not confirmed exactly. Lateral flap bears 6-7 setulae each. Manubrium with ca. 4 + 4 smooth erecting setae dorsally. Dens (Fig. 2 H) is very long, with many winged setae, 12-13 on outer and 13 on inner side and with ca. 4-5 ciliated dorsal setae. Proximal group is an assembly of ca. 8 setae including a long, smooth seta, while others are ciliated. Mucro (Fig. 2 I) is elongate, subequally quadridentate.

The additional diagnosis above is only to certify that the species is surely to be regarded a member of the genus *Cyphoderus*, although the ventral tube is a little deviated, which is to be checked by the fresh examples. The species seems to be widely distributed in South Africa and Madagaskar.

Cyphoderus (Cyphoda) *marocanus* (Delamare) Fig. 2 J–N

Cyphoderus marocanus: Delamare 1948

MAROCCO: Rifi (9 slides, Thibaud leg. et det.)

Labrum with setae 4/5, 5, 4, all smooth. Outer max. lobe with setae 2/II + 2. Setae of labial basis (Fig. 2 K) as m-e/l(l). Clypeal area (Fig. 2 J) without additional setae, prefrontals and other 2 smaller facial setae are barbed. Frontal setae all barbed, f-0 is a sensilla, f-4 smaller than others. Fore margin of th. II only with short setae sparcely dispersed.

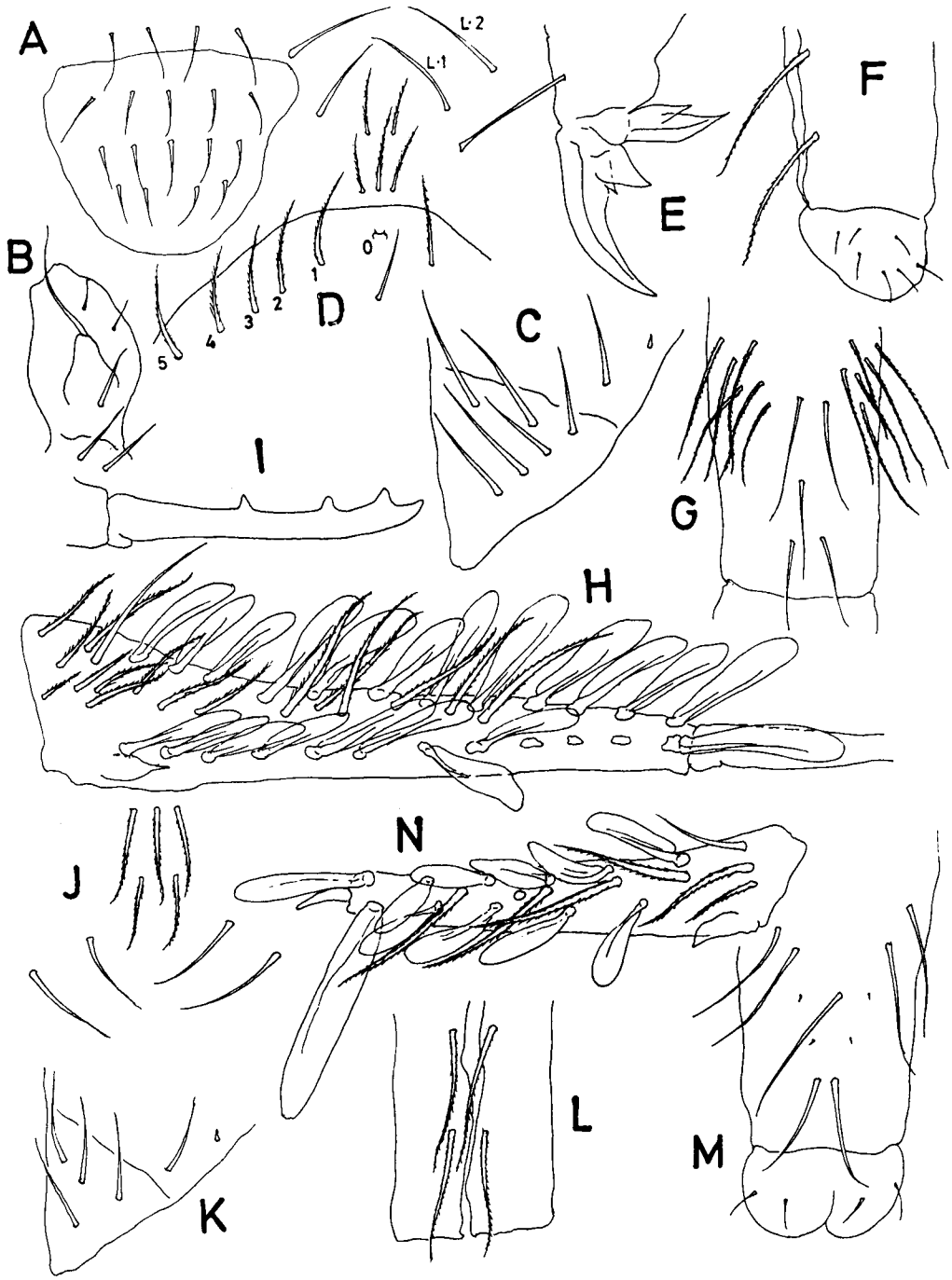

Fig. 2. *Cyphoderus omoensis* Delamare from Angola.
A: labrum, B: outer max. lobe, C: labial basis, D: clypeal & frontal setae, E: hind tarsus, F, G: ventral tube (lat. post.), H: dens, I: mucro.
Cyphoderus marocanus (Delamare) from Tunisia.
J: facial setae, K: labial basis, L, M: ventral tube (ant. & post.), N: dens & mucro.

Ventral tube (Fig. 2 L, M) anteriorly with 2 + 2, long, barbed setae. Posterior side has 2 distal smooth, one median proximal and 2 + 2 lateral barbed or poorly ciliated setae plus 2 + 2 pegs. Lateral flap with 2 + 2 setulae. Dens (Fig. 2 N) bearing 6 outer and 5 inner row of winged setae, the inner, distal one is very large and strong, as if it is to restitute the short mucro. Dorsal setae 4, all barbed. Proximal setae 3, the outer one is smooth and others barbed. The median seta is very large. Mucro reduced acuminate distally and almost 1/10 of dens in length.

As may be seen from the diagnosis above, it is impossible to find out any fundamental difference to *C. albinus* except that the mucro is reduced. Therefore, it is apparently possible to regard *Cyphoda* Delamare 1948 as a subgenus for which the species is the type. However, other species placed in *Cyphoda* may be checked one by one. *C. lantohi* Yoshii, 1987 and *C. limboxiphius* Börner 1913 are surely to be in *Cyphoda*.

Cyphoderus (Cyphoda) *limboxiphius* Börner

C. limboxiphius: Börner 1913
Cyphoda limboxiphius: Delamare 1945

KENYA: Mt. Elgon (1 slide, 30. XII 1932, Jeannel leg., Delamare det.)

In this one example at hand, dental winged setae are 5-6 on outer and 5 on inner side, just as in *C. marocanus*, but mucro is longer. Dorsal setae are 4, barbed. Other details are, however, not to be inspected.

Cyphoderus asiaticus Yoshii Fig. 3

Cy. asiaticus: Yoshii 1959

SINGAPORE: Bukit Timah (2 ex. 17. XI 1987)

The diagnosis of this species is incomplete being described from one example. Actually, the species is peculiar in various respects and additional notes are to be given herewith based on topotypical examples. Labrum (Fig. 3 A) with setae 4/5, 5, 4, prelabrals smooth and outer pair of the second row are proximally dislocated. Labral margin without structures. Labial setae as mmre/l(l), where (l) is residual. Mandible and maxillary head normal for the genus and outer maxillary lobe (Fig. 3 B) is with setae as 2/II + 2. Hind tibiotarsus is bearing a posterior row of three smooth setae. Ventral tube (Fig. 3 E) is anteriorly with 2 + 2 (rarely 3) ciliated setae. Posterior face has, in contrast to usual pattern of the genus, with 4 distal setae plus 2 unpaired, median seta and, in addition, 3-5 lateral setae together with 3 + 3 pegs. All of them are smooth. Lateral flap bears 7 setulae. Manubrium is dorsally with some 8 smooth setae mixed with the usual ciliate ones. Ventrally the scales are ovate and distal setae are 1 + 1, barbed. Dens (Fig. 3 H) bears 8 outer and 7 inner row of scaly setae and a dorsal row of 6 small, ciliated setae, which is confined to the proximal half of its length. Basal group is composed of 2 small outer and 3 ciliated inner setae. Scales of the ventral side are broadly ovate.

Setal pattern of the trunk is the usual type for *Cyphoderus* and *Serroderus* (Yoshii 1980, p. 6, fig. 2), but the setal arrangement of frontal area of the head is peculiar. In all species known so for, there is one paired residual organ at the centre (f-0), to which one small seta is attached behind. In this species, however, this small seta is occupying the locus of f-0 and

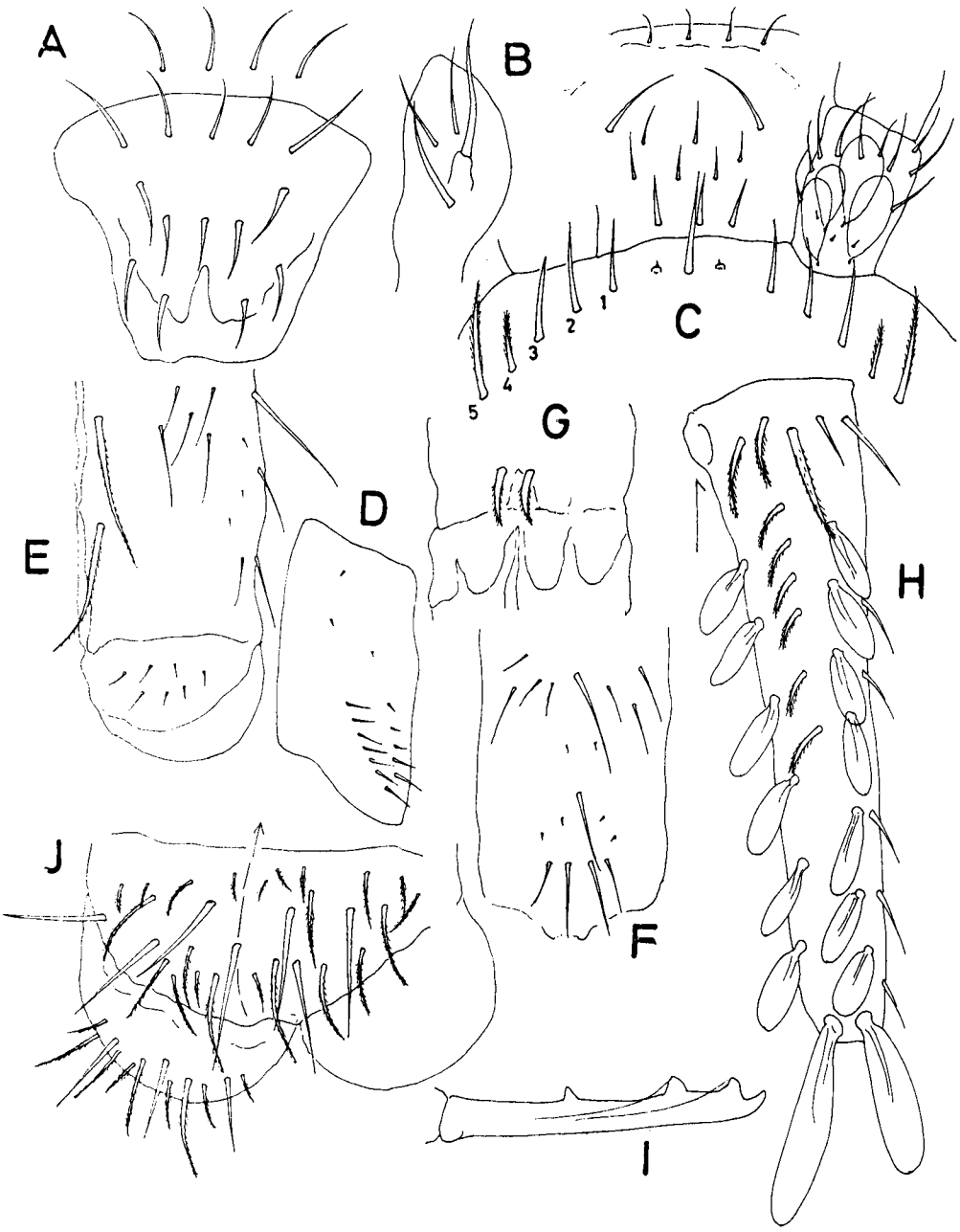

Fig. 3. *Cyphoderus asiaticus* Yoshii from Singapore.
A: labrum, B: outer max. lobe, C: facial & frontal area, D: trochanteral organ, E, F: ventral tube (ant. & post.), G: distal end of manubrium, H: dens, I: mucro, J: abd. IV.

well developed, while the residual organ is divided to one pair on both sides of the seta (Fig. 3 C). From five pairs of the frontal setae the first two (f-1, f-2) are smooth, while the others are barbed. From the clypeal area three prefrontals are smooth, rather small and equal in length, while the other facial setae are irregularly arranged and smooth. Setae of the fore margin of thorax are in one row and median seta is not modified. Upper anal flap of abd. VI (Fig. 3 J) bears 7 smooth setae together with many ciliated, usual ones and each lateral flap is with 3 such smooth ones.

From the usual *Cyphoderus* the species is quite different in the ventral tube, which is more alike to *Serroderus*, but dens is with a dorsal row of setae and with broad, ovate scales on ventral side. Peculiar arrangement of the setae of the head is also unique. In some respects the species is possibly nearly related to *C. bidenticulatus* Parona.

***Cyphoderus bidenticulatus* Parona** Fig. 4

C. bindenticulatus: Parona 1888, Börner 1903, Stach 1922, 1929, Delamare 1948

LEBANON: Gr. de Dahr (1 slide 27. IX 1951, 1 slide 16. X 1951); FRANCE: Veneris (5 slides 4. VI 1922); BELGIUM: Verdun (2 slides 4. VI 1922)

The species is already well known of its details. Additional diagnosis to Stach 1922 and Delamare 1948 is as follows: Labrum (Fig. 4 A) with setae 4/5, 5, 4, all smooth. Outer max. lobe with setae 2/II + 2. Setae of labial basis (Fig. 4 B) as mm(r)e/l(l) or even mmm(r)e/l(l). Facial area with few setae, all smooth, including three prefrontals. Frontal setae all ciliated, f-0 is a paired minute sensillae and there is one seta just behind of it. f-4 is smaller than others and f-2 is either ciliated (Belgium ex.) or smooth (Lebanon ex.). Ventral tube is more alike to *Serroderus*, i. e. posterior side is distally with 4 smooth distal setae. Proximal unpaired seta is smooth and, besides, there is a pair of intermittent setae between them, which seems to be either smooth or barbed (asymmetric in one example). Lateral setae 2 + 2, barbed and with 2 + 2 pegs. Lateral flap is with 3-4 setae on each side. Furca with man:d:mu as 40:30:15. Dens (Fig. 4 E) is dorsally with winged setae 7 on outer and 5 on inner row. Dorsal row of setae 4, all barbed. Proximal setae seemingly all barbed. Mucro (Fig. 4 F) is typically tridentate equally and with a lateral ridge. As may be seen from above, the species is alike to *C. asiaticus* in the chaetal pattern of the ventral tube, having *Serroderus* type of it. The difference of frontal setae between Libanese and others seems to be checked further on. The difference to *C. albinus* is not restricted to mucronal form, but also in the number of dental winged setae, as already reported by Stach 1922, p. 26, so that it is 7 instead of 6 of *C. albinus*.

***Paracyphoderus dimorphus* (Silvestri)** Figs. 5 A-O, 6 A – C

Cyphoderus dimorphus: Silvestri 1910

Paracyphoderus dimorphus: Delamare 1948

PANAMA: Carti Road, from the nest of *Melipona fasciata* (73 ex. 25. X 1988, T. Inoue leg.)

Body length ca, 1. 8 mm., not depressed. ant:head 20:8, segm. ratio 3:6:5:8. Ant. I, II with scales dorsally near the basis. Ant. IV without apical bulb. Ant. III-organ (Fig. 5 A) is two small rods quite near distal end. Ant. II (Fig. 5 B) is distally either with a prominent production on dorsolateral side (male) or only with a faint swelling (female). Ant. I, II are,

besides, with strong setae, but no distinction between sexes. Labral setae 4/5, 5, 4, all smooth and with large sockets. Distal margin entire. Outer max. lobe (Fig. 5 D) is with setae 2/II + 1, all smooth, apical seta is small. Instead, the basal and one peripheral seta is strongly deveped, much larger than the apical seta. Maxillar head (Fig. 5 E) slightly modified, the capitulum is with two teeth and lamellae are lightly surpassing the capitulum. Mandible is not modified, with well developed molar plate and 5-6 toothed apex. Labial setae (Fig 5 F) as m-e/l(l), just as in *Cyphoderus* spp. Legs unscaled. Coxa is with very long, barbed setae, femur and tibiotarsus with one strong seta proximally and, besides, there is a row of smooth setae along its posterior side. Unguis (Fig. 5 H) is small, only the outer basal tooth is well developed and no inner tooth. Dorsal teeth are rather well developed. Unguiculus is lanceolate, with one prominent outer tooth. Tenent hair is strongly developed, elongate and spathulate distally. Trochanteral organ (Fig. 5 I) is ca. 20 smooth setae arranged in L-shape. Ventral tube (Fig. 5 J, K) not scaled. Anterior side has ca. 10 + 10 smooth setae, larger proximally. Posterior side is with the typical setal arrangement of *Cyphoderus*, the distal paired and a median one seta are smooth, the lateral 2 + 2 are

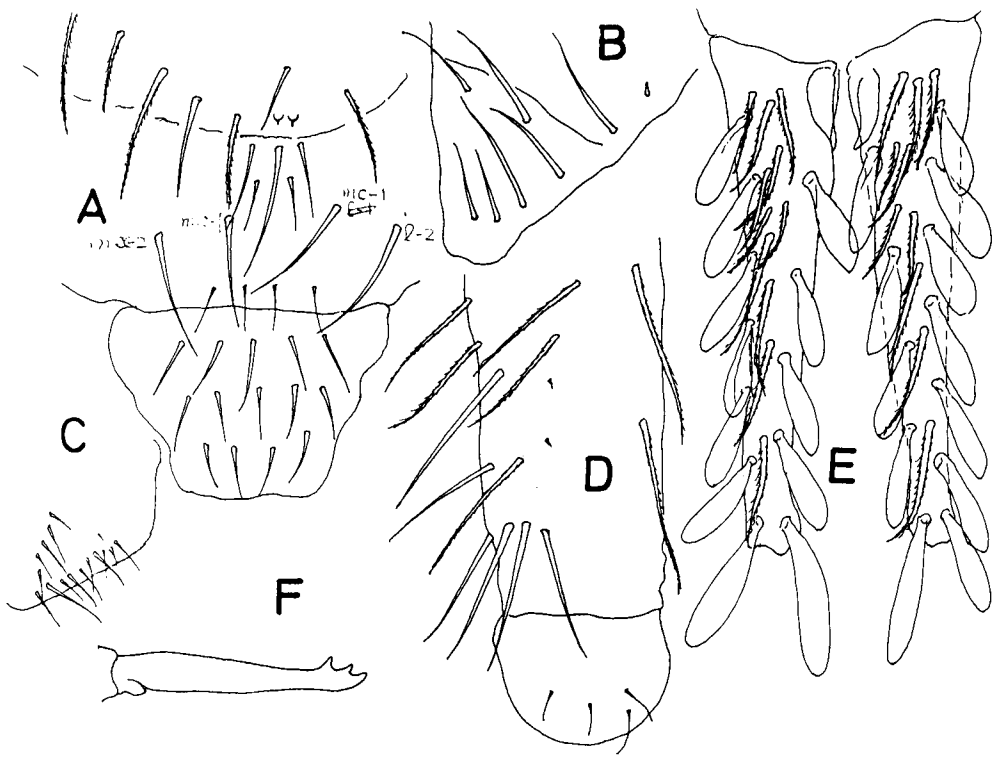

Fig. 4. *Cyphoderus bidenticulatus* Parona from Lebanon,
A: labrum, facial and frontal area, B: labial basis, C: trochanteral organ, D: ventral tube (post. lat.), E: dens, F: mucro.

barbed and long. There are also 2 + 2 pegs to the side. Lateral flap with ca. 12 smooth setae each. Terminal tubule smooth. Furca short, man:d:mu as 10:8:3. Manubrium ventrally with small, oblong scales, the distal setae (Fig. 5 L) very small and barbed. Dorsal side is with many large and small, all barbed setae. Larger setae are distally clubbed and almost in a symmetrical pattern as fig. 5 M. Dens (Fig. 5 N, Fig. 6 B) is with 7 winged setae both in outer and inner row. Dorsal row of setae are 7-8, all barbed and one seta from the distal half is turned to the winged seta, quite alike to the lateral ones, although it is smaller in size. Proximal setae are 4, the outer one is smooth, others are strongly barbed. The distal winged seta of both sides are elongate, subequally large and attaining the anteapical tooth of mucro. Ventral side of dens is scaled with oblong scales not much elongated. Mucro (Fig. 5 O) is straight, bidentate apically, the anteapical one is with a lamella on its proximal side. Upper anal flap (Fig. 6 C) is with 7 barbed, thick setae, lateral flap is with 6 of them in both sexes. Genital orifice (Fig. 6 A) is transverse in female and longitudinal in male, both of them are, however, not appended by any setulae. On area facialis (Fig. 5 G), three prefrontals and other facial setae are barbed and from 2 + 2 lateral setae, the proximal pair is rugose, the other distal pair is almost smooth. On the frontal area f-0 is a residual organ, f-1 is small, but f-2 to f-5 are all well developed and barbed. Cervical setae quite absent. Marginal setae of th. II are small and subequally large. s. s. of abd. II–IV are as 2, 3, 3, accompanied by small setulae near their basis, which are, however, quite absent by the distal s. s. of abd. IV, which may mean the another nature of this seta.

Our examples coincide well with the old, but exact description of Silvestri 1910 reported from the nest of *Trigona cupira* Smith in Mexico, for which the genus *Paracyphoderus* Delamare 1948 was established. The only difference to his description is that setae of abd. V, VI of male has no specific difference from that of female, for which further researches must be made with the topotypes. The species is different from *Cyphoderus* not only by the sexual difference of antennae, but also in the number of setae on anterior side of ventral tube and by the presence of smooth setae of tibiotarsus. Setal arrangement of dens is widely variable, the number of winged setae are usually 7, 7, but it may be 7, 8 or 8, 8. Dorsal setae are more variable, being 7-9 in number and not only one, but two or three of them may be turned to winged setae.

Serroderus Delamare, 1948

type species: *Cyphoderus distinctus* Denis, 1945

When the genus is reviewed in Yoshii 1987, two key characters were mentioned: i. e. the absence of dorsal setae of dens and the arrangement of setae on posterior side of the ventral tube (1. c. Fig. 2, A and B). With the finding of details of other species, it is now cleared that only the first character is valid. The second character is existing in some species of *Cyphoderus*. But it is not in vice versa, so that *Cyphoderus* type of ventral tube has not been detected as yet in the genus *Serroderus*.

Serroderus distinctus (Denis) Fig. 6 D–F

Cyphoderus distinctus: Denis 1945
Serroderus distinctus: Delamare 1948

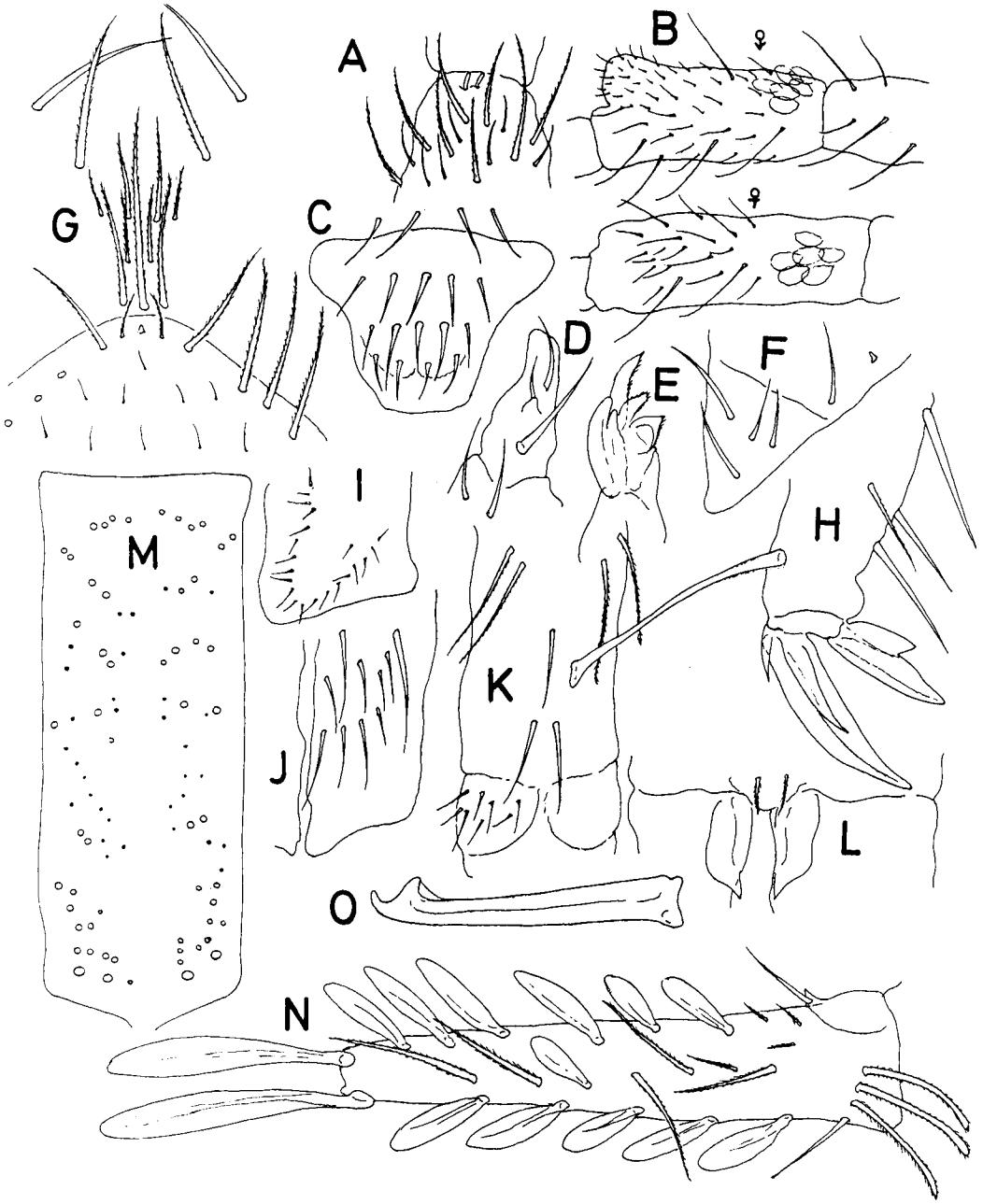

Fig. 5. *Paracyphoderus dimorphus* (Silvestri) from Panama.
A: ant. III, B: ant. II (male and female), C: labrum, D: outer max. lobe, E: maxillar head, F: labial basis, G: facial & frontal area, H: hind tarsus, I: trochanteral organ, J, K: ventral tube (ant. & post.), L: distal end of manubrium, M: chaetal pattern of manubrium, N: dens, O: mucro.

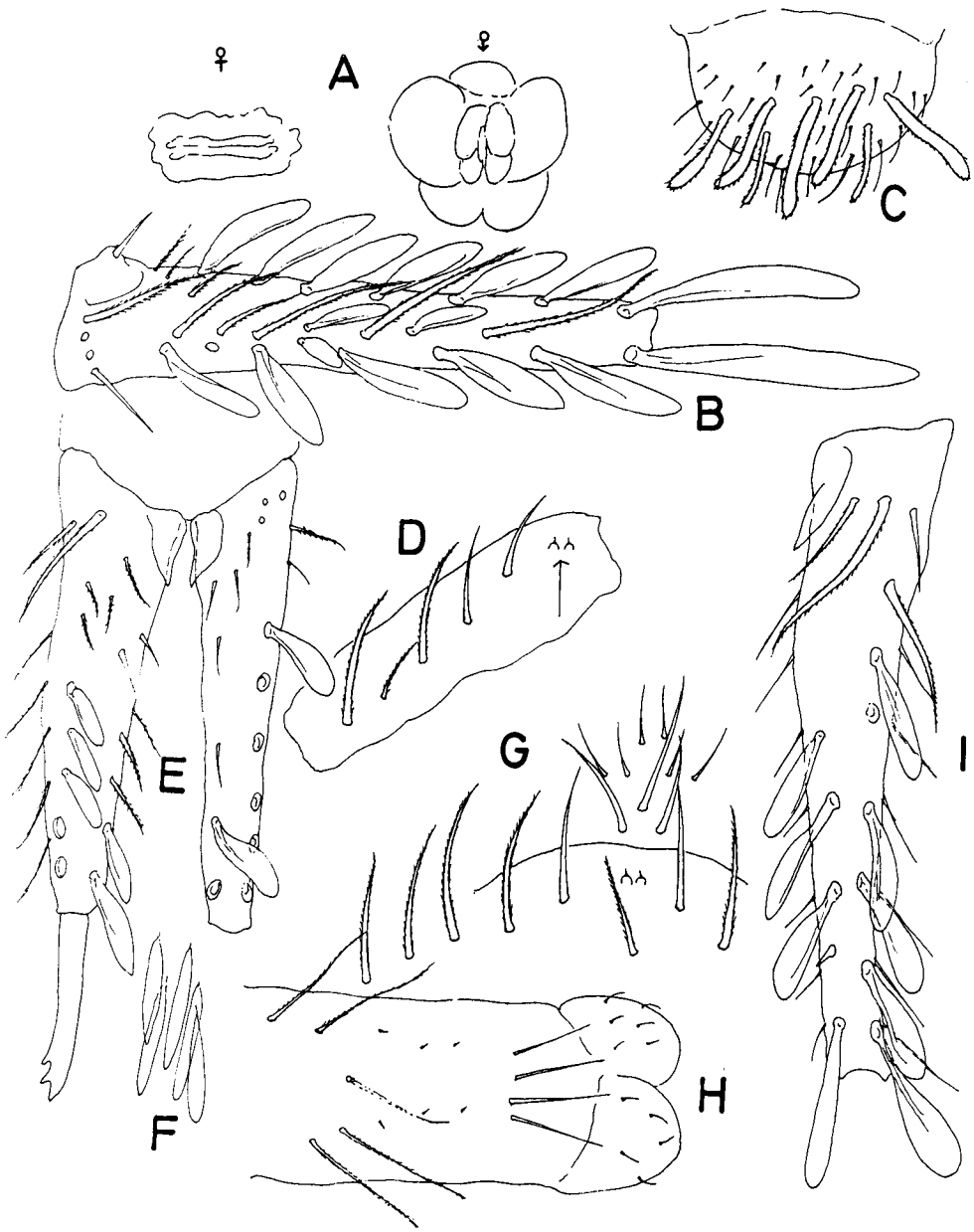

Fig. 6. *Paracyphoderus dimorphus* (Silvestri), continued.
A: male & female genital orifice, B: dens of another example, C: upper anal flap.
Serroderus distinctus (Denis) type.
D: frontal setae, E: dens & mucro, F: ventral scales of dens.
Serroderus tridenticulatus (Denis) from Vietnam.
G: clypeal & frontal area, H: ventral tube (post.), I: dens.

IVORY COAST: Abidjan (1 slide, Grasse leg., Denis det.)

What can be observed from one slide is as follows: Prelabral setae 4, all smooth. Setae of facial area all smooth. From the frontal area (Fig. 6 D), f-0 is a minute pair of sensillae, f-1, 2 are smooth, f-3, 4, 5 are barbed an f-4 is smaller. Trochanteral organ poorly developed, it is ca. 16 setulae in L-form. Ventral tube is not to be observed. Number of winged setae of dens variable as already mentioned in Denis. In one example at hand, it is 5-6 on outer and 2 on inner side, but after Denis 1945, fig. 1b, it is either one or two. There exists a row of slender setae to the ventral side of these rows, which are 6 on outer and 5 on inner side. Dorsal row of dental setae is quite absent. Proximal group is 3 barbed setae, to which some 5 smaller setae (3 smooth) are appended. Ventral side of dens is with naroow scales (Fig. 6 F). Mucro tridentate, with a lateral toothlet, the latter is often enlarged as if it is an another tooth. With this results the validity of the genus *Serroderus* as defined in Yoshii 1987 is assured.

***Serroderus tridenticulatus* (Denis)** Fig. 6 G – I

Cyphoderus tridenticulatus: Denis 1948

VIETNAM: Deo Ca et Cauda (3 slides, Dawydoff leg., Denis det.)

Body length ca. 1. 5 mm. Ant. ratio as 3:8:4:10. Only ant. I scaled. Labrum with setae 4/5, 5, 4, all smooth. Median seta of the first row lightly smaller, margin with two tubercles. Outer max. lobe with setae 2/II + 2. Setae of labial basis as mre/l(l). Facial area (Fig. 6 G) with few setae, all three prefrontals smooth. From the frontal area, f-1 is smooth, while others are barbed and equally long. Anterior margin of th. II with a row of small, ciliated setae, the median pair is not observed. Unguis with unequally broad inner basal teeth and one distal tooth. Unguiculus with a large outer tooth as usual. Tenent hair long, truncate distally. Trochanteral organ with ca. 20 setulae in L-arrangement. Ventral tube (Fig. 6 H) anteriorly with very few, long, ciliated setae. Posterior side is with 4 smooth distal and 2 + 2 lateral ciliated setae. One median proximal seta seems to have been fallen off and there are more than 3 + 3 minute pegs. Lateral flap bears 6-7 setulae each. Furca with man:d:mu as 16:12:6. Dental end of manubrium is thickly articulated, with an inner process and with 1 + 1 terminal setae. Dens (Fig. 6 I) bears 6 outer and 3-4 inner winged setae and with a residual spinose seta between the first and second of the inner row. Dorsal setae absent. Proximal setae 4, outer one is smooth, others barbed and one of them is elongated. To the underside of winged setae, there is a row of 6-7 slender setae on both sides. Mucro is elongate, one apical and 3 dorsal teeth are almost equally large.

By the absence of dorsal row of dental setae and by its ventral tube, the species belongs to *Serroderus* (sensu Yoshii 1987) without doubt.

***Serroderus mango* sp. n.** Fig. 7

SINGAPORE: Bukit Timah (4 ex. 17. XI 1987)

Body length ca. 3 mm, white. ant:head 10:12, segm. ratio 10:25:12:35. Ant. I, II dorsally scaled. Ant. III, IV densely covered with curving, small sensory setae, especially the dorsal side of IV is almost only with such setae. Labral setae (Fig. 7 A) 4/5, 5, 4, median seta of the first row small. Second and third row are with large sockets. Labral margin

with 1 + 1 small tubercles. Mandible and maxilla not modified. Outer max. lobe with setae 2/II + 2. Setae of labial basis as mre/l(l). Three prefrontals (Fig. 7 B) all smooth, whose median setae are larger. On frontal area f-0 is residual, f-1 is smooth, f-2 to f-5 are barbed. Anterior margin of th. II is with a row of short setae, the median pair is elongate, barbed as usual for *Serroderus* and there is another macroseta near the posterior lateral corner of the segment. Legs are without smooth setae. Trochanteral organ is V-shape, composed of ca. 20 spiny setulae. Unguis (Fig. 7 C) normal, without inner distal tooth, but with a small rounded dilation near the paired basal teeth. Unguiculus with a broad outer tooth. Tenent hair short, truncate on apex. Ventral tube (Fig. 7 D) anteriorly with 2 or 3 long, ciliated setae on one side. Posterior side has 4 distal and 2-1-2 proximal setae plus 3 + 3 pegs. Lateral flap bearing 6 setulae each. Furca with man:d:mu as 14:7:3. Manubrium (Fig. 7 E) is dorsally with a broad median, glabrous stripe and the setae along its side are smooth, while those to the outer side and distal part are barbed or ciliated. Ventrally, it is scaled and with 1 + 1 barbed terminal setae. Dens (Fig. 7 G) is lightly converging, with 6 outer and 3 inner winged setae to which one barbed seta is proximally attached to each row. Dorsal row is absent. Proximal group consists of 5 setae, the inner two are barbed and others are smooth. One of the barbed seta is elongate and lightly clavate distally. The ventral scales of dens are elongate, fusiform and in 2-3 rows. Mucro (Fig. 7 H) is quadridentate, apical 3 teeth are subequal and the fourth is at about the middle. A small denticule with long ridge is near the second tooth.

By the chaetal pattern of th. II etc., the species is very near *S. durio* Yoshii, 1987, although the furcal setae are not multicuspidate. Besides, the dental scaly setae of the inner row are less in number and on the dorsal side of manubrium, the setae along the median stripe are all smooth and not mixed with barbed ones. The species is more nearly related to *S. tridenticulatus* (Denis), but dens is shorter, about half the length of manubrium. Also, they are different in the chaetal pattern of the ventral tube and in the dental setae, whose inner row of winged setae are always 3 and no spinulate seta between them. Anyway, both of them are near relatives and we may assume the existence of a group of vicarious species with 4 mucronal teeth in Southeast Asia, which may be keyed out as follows:

1. Ventral tube anteriorly with many short setae ..... *S. sabahnus* (Yoshii, 1980)
   Ventral tube anteriorly with few long setae 2
2. f-1 of the frontal setae smooth 3
   f-1 of the frontal setae barbed ..... *S. alfredi* (Yoshii, 1959)
3. Some setae of manubrium and dens either strongly multicuspidate or strongly rugose ..... *S. durio* Yoshii, 1987
   Not as above 4
4. Dens with one spinose seta among winged setae of the inner side .... *S. tridenticulatus* (Denis, 1948)
   Dens without such spinulate seta 5
5. Anterior side of ventral tube with 2 + 2 smooth setae .... *S. dicuspiditermitis* (Yoshii, 1980)
   Anterior side of ventral tube with more than 3 + 3 barbed setae .... *S. mango* sp. n.

***Serroderus hozawai* (Kinoshita)**

Cyphoderus hozawai: Kinoshita 1917, Gapud 1971
Serroderus hozawai: Yayuk 1989

JAVA: Bogor Botanical Garden (13 ex. 23. III 1988), G. Ungaran (2 ex. 15. VII 1987),

The identity of the generic position is confirmed once again. It would appear that the synonymy of *C. orientalis* Folsom, 1924 from Sinabang Island in Gapud 1971 seems to be

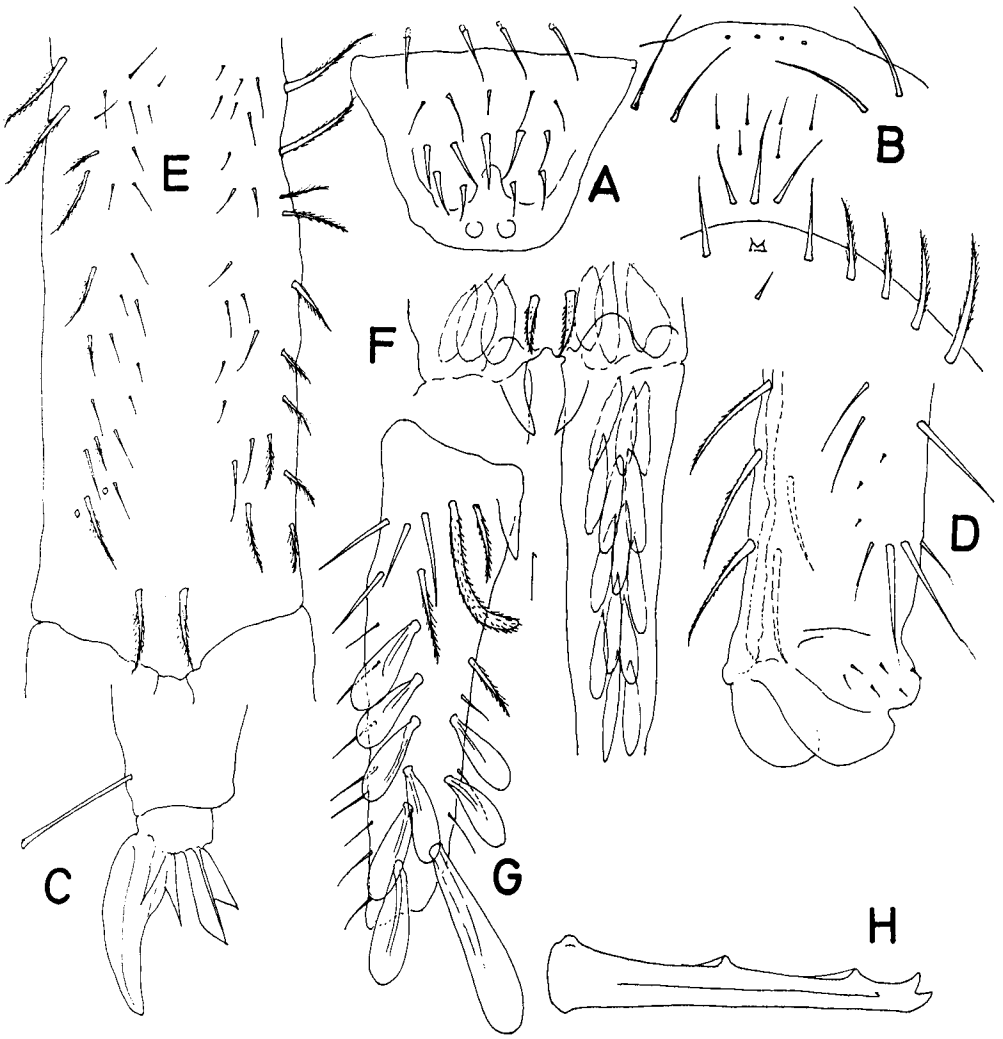

Fig. 7. *Serroderus mango* sp. n.
A: labrum, B: facial & frontal setae, C: hind tarsus, D: ventral tube, E: chaetal pattern of manubrium, F: ventral view of manubrium and dens, G: dens, H: mucro.

well established.

Distribution: Japan, Philippines, Borneo, Singapore, Java, Sumatra.

***Cyphoderodes* Silvestri, 1911**

type species: *Cyphoderodes ceylonicus* Silvestri, 1911

In tropical Asia, there is a series of termitophilous species of Cyphoderidae, all of which are conspicuous by the presence of barbed prelabral setae. The body is depressed, with reduced mouth parts and unguis is modified in various ways. They have been placed in various genera, but their identification is not possible for the moment, so that all of them may be regarded as congeneric. This conclusion is suggested by our colleague, Prof. G. H. Murphy of Singapore, to whom I must express my sincere gratitude. As the type species is not sufficiently known, it is to be represented here by another alike species, *Cyphoderodes punjabicus* Yoshii et Ashraf, 1964 to represent the subgenus *Cyphoderodes* (s. str.). Accordingly, not only the prelabral setae, but also some of the labral setae are barbed. Dens is with a dorsal row of setae and mucro is straight, bidentate apically. Mandible and maxilla are half modified. Unguis is bulbously degraded, and its inner tooth is with a filamentous tendril. Tenent hair is barbed. *C. dubius* Börner, 1913 may be *Cyphoderodes* (s. str.), but *Cyphoderodes xenopus* Börner, 1913 of Brazil may belong to the different group.

Other subgenera of the genus are to be defined as follows:

Pseudocyphoderus Imms, 1912: The type species, *P. annandalei* Imms, 1912 is characterized by the presence of strongly reduced mucro and tunicate uniguis. Notes of Mitra 1976 did not give any further details. Other species of *Pseudocyphoderus* from Africa may not belong to the same group.

Delamarerus Mitra, 1976: The type species is peculiar having the ventral tube anteriorly with many smooth setae, Posterior side is with "a few setae". Unguis has a broad tunica and multidentate pseudonychia. Inner tooth is also multicuspidate and with a tendril. Unguiculus lanceolate. Mucro straight, ending in two teeth. With its peculiar form of unguis, it is easily to be identified, but the relation to other groups is not yet cleared.

In conclusion, we have following species to be registered in the genus *Cyphoderodes*.

Cyphoderodes (Cyphoderodes) ceylonicus Silvestri, 1911 ..... Ceylon
Cyphoderodes (Pseudocyphoderus) annandalei (Imms, 1912) ..... India
Cyphoderodes (Cyphoderodes) dubius (Börner, 1913) ..... India
Cyphoderodes (Cyphoderodes) punjabicus Yoshii et Ashraf, 1964 ..... Pakistan
Cyphoderodes (Delamarerus) immsi (Mitra, 1976) ..... India
Cyphoderodes (Cyphoderodes) mitrai (Yoshii, 1987) ..... India
Cyphoderodes (Cyphoderodes) yayukae (Yoshii, 1987) ..... Java
Cyphoderodes (Cyphoderodes) singaporicus Murphy et Yoshii, sp. n. ..... Singapore

***Cyphoderodes (Cyphoderodes) singaporicus* Murphy et Yoshii, sp. n.** Fig. 8 A–L

SINGAPORE: Bukit Timah Hill (4 ex. 17. XI 1987)

Body length ca. 1.0 mm, totally white. General shape depressed, head hypognathous. ant:head 10:10 segm. ratio 10:15:10:25. Ant. I, II are scaled dorsally. Ant.II is with one

s.s. on ventral side. Ant. III is clavate, with many small, curving sensillae, which are also abundant on ant. IV. Labrum (Fig. 8 A) with setae 2/4, 5, 4, prelabrals and the first row are distinctly barbed, while others are smooth. Outer maxillary lobe (Fig. 8 D) with one barbed seta representing the apical seta of the papilla. Mandible (Fig. 8 C) with 4-5 apical teeth and its molar plate is reduced in size and in number of teeth. Head of maxilla (Fig. 8 E) is simplified, capitulum is tridentate and lamellae are reduced, not fringed. Setae of labial basis (Fig. 8 F) is as m-e/ll, all barbed including the setae of the same area. From three prefrontals, the median seta is larger and barbed, while the lateral pair is only rugose and short. Two pairs of lateral setae are rugose, lat-2 is smaller. On the frontal area, f-0 is a residual organ, then follows f-1 to f-5, larger posteriorly, but f-4 is small. Legs short, tibiotarsi without smooth setae. Trochanteral organ is reduced to an oblique row of ca. 6-7 setulae. Unguis (Fig. 8 H) is dorsally carinate, but not tunicate, with a pair of proximal and one large distal tooth. Very often, the distal tooth is with a setaceous tendril-like process exceeding the tooth. Unguiculus elongate, with a broad outer tooth. Tenent hair is short, apically spathulate and ciliated all through the length. Ventral tube (Fig. 8 I) anteriorly with 4-5 ciliated setae to each side. Posterior side is with 2-3 small distal setae and 2-3 proximal smaller ones, all smooth. Lateral flap bears 3 ciliated setae each. Rami tenaculi quadridentate, corpus with one seta. Furca in ratio as 25:13:10. Manubrium ventrally only with scales, the dorsal side is subdivided into two parts and setae are arranged almost in a symmetrical way, Its proximal half is only with barbed setae, whereas in the distal half, some smooth setae are mixed. Dens (Fig. 8 K) is short, with 5 winged setae on outer and 2 on inner row. Dorsal row is 3 ciliated setae. Proximal group is two barbed setae, one of which is longer than others and often with one additional seta attached to the outer side. Ventrally, dens is with very elongate scales (Fig. 8 L) proximally and with thin, setose scales distally. Manubrial thickening is produced triangularly and with pointed apex. Mucro is elongate, somewhat curving and simply bidentate. The inner distal scaly seta is attaining almost to the mucronal apex. Chaetal pattern of the body is quite different from that of *Cyphoderus* and *Serroderus*, there being no macroseta, but only with many small, rugose setae, which are arranged symmetrically on th. II to abd. III and a little at random on the head and on abd. IV. Noteworthy that abd. II, III has no such seta except around s.s., whose number is 2, 3, 3 on abd. II, III, IV respectively, each of which is provided with some small, barbed or smooth setulae. But their arrangement seems to be not very constant. A pair of pseudopores are present on th. II to abd. IV. Abd. V, VI bears no smooth setae.

The species is close to *Cyphoderodes punjabicus* Ys. et Ash. from Pakistan, differing from it by the number of labral setae and of the anterior side of the ventral tube as well as by the absence of tunica of unguis. It is also different from *Cyphoderodes yayukae* (Ys.) of Java by the setae of labrum, which are all ciliated in the cited species. Since the present species is very near *C. punjabicus* in other details, we have to place it in the same taxon, although it has no tunicated nor degenerated unguis.

***"Cyphoderus serratus"* of Vietnam** Fig. 8 M

VIETNAM: Dalat (4 slides, Dawydoff leg., Denis det.)

There seems to exist more than two species under this name. Denis 1948 mentioned

the "présence de soies lisses sur les facies internes de tibias", so that it may be included in *Mimoderus* Ys., while all slides above have no such smooth setae of legs. Besides, anterior margin of th. II (Fig. 8 M) is with long, ciliated setae in its full length and abd. VI is beset with some 6 smooth setae on it. *"C. serratus"* of French Guiana in Denis 1925 has also such a marginal tuft of th. II, but only with 1 + 1 smooth setae on abd. VI. It is attractive for me that the so called "multidentati" is an assembly of various species and that all of them must be reviewed once again from the new standpoint of view.

Discussion

From the results above, it is possible to argue various problems regarding the new key characters hitherto incompletely utilized. These characters are to be arranged in a certain series of forms from the simple, primordial to the more complicated, modified forms as to be

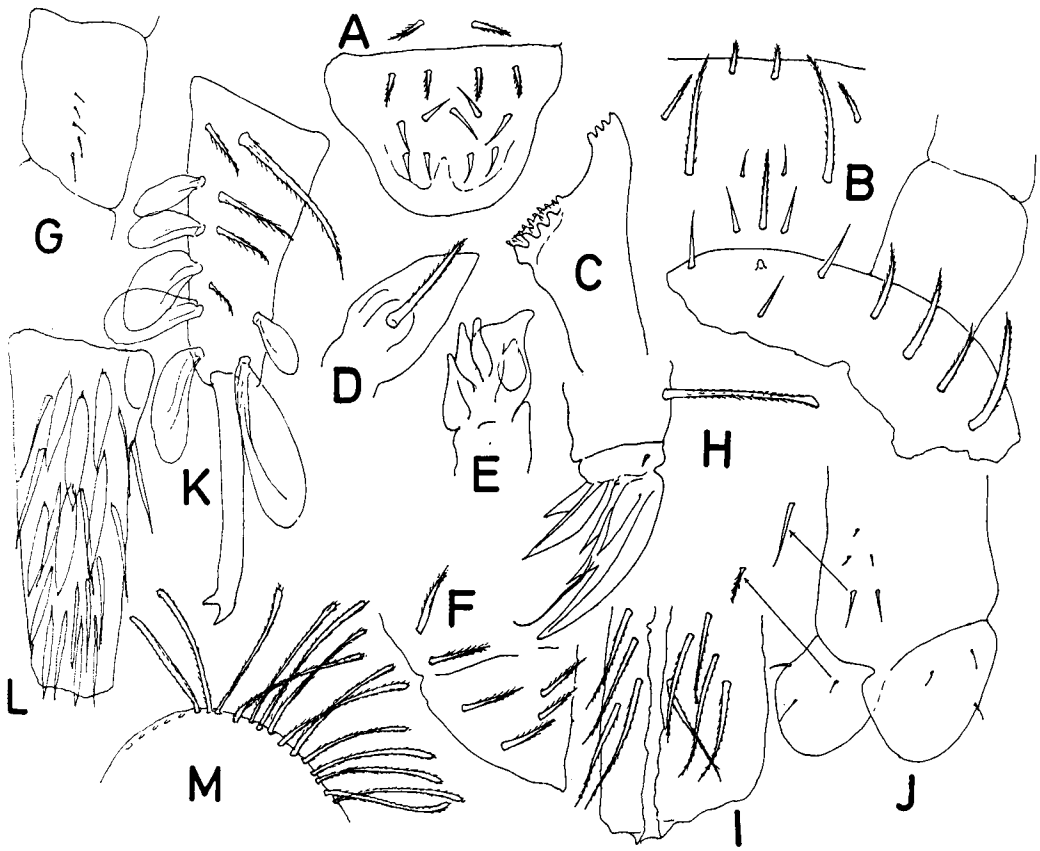

Fig. 8. *Cyphoderodes singaporicus* Murphy et Yoshii, sp. n.
A: labrum, B: facial & frontal setae, C: mandible, D: outer max. lobe, E: maxillar head, F: labial setae, G: trochanteral organ, H: hind tarsus, I, J: ventral tube (ant. & post.), K: dens & mucro, L: ventral scale of dens.
"Cyphoderus serratus" of Vietnam.
M: anterior margin of th. II.

stated below:

1. Labrum: The primary form is 4/5, 5, 4, all smooth, setae are subequally large and margin is without structures. The setae are going to be unequal and some marginal structure may appear. In *Cyphoderodes* spp. of tropical Asia, the prelabral and other labral setae are barbed and its number is varying up to 2/4, 5, 4 (Fig. 8 A).

2. Outer maxillary Lobe: There is no Cyphoderid species having the form of 2/II + 3, which is fundamental for all Entomobryidae. Usually it is 2/II + 2 and going to reduce to 2/II + 0 (Fig. 8 D).

3. Mandible and Maxilla: It is already known that they are going to reduce in African forms such as *Cephalophilus, Calobatinus* etc. In case of *Mimoderus saikehi* Yoshii, 1980 maxillar head is deformed, even when the body form is not at all modified.

4. Labial Basis: The simplest pattern is m-e/l(l), so that r is absent, which is alike to the case of Hypogastruridae. In others, it is as mre/l(l), like that of Isotomidae. They are even as mmre/l(l), but the most lateral one is always in form of a residual organ.

5. Facial Area: Facial area means the area between labrum and fore margin of the head. The area is already well investigated in Symphypleona by various authors, but quite neglected in Arthropleona because of its difficulty for observing. Luckily, in our Cyphoderidae and especially in hypognathous forms, it is very easy to observe and, accordingly, we have following results. Fig. 2 D is the simplest case of the chaetal pattern of the area, by which there are 3 prefrontal setae just before the frontal area of the head. They are either smooth or barbed, either subequally large or not after the species. Anterior margin of the facial area is occupied by prelabral setae and just posterior to the prelabrals, there is a transverse, glabrous area, without any setae, which is margined laterally by 2 + 2 long setae to be named as the lateral setae (L-1, L-2). Some smaller setae are present between the prefrontals and lateral setae, which are either smooth, barbed or mixed with both of them. In the simplest case, these facial setae are only 1 + 1 (Fig. 4 A) or 2, 4 (Fig. 7 B) but sometimes very many and arranged at random.

6. Frontal Area: There is always one sensillate organ (f-0), followed by 5 + 5 setae along the antennal basis, to be named as f-1 to f-5, to be named reverse to my proposal in Yoshii 1980. Some of them are smooth, but usually barbed and f-4 is often smaller than others. Posterior to sensilla f-0, there is a smaller seta f'-0, which takes the place of f-0 in case of *C. asiaticus* (Fig. 3 C). The head capsule is beset with many microsetae, whose arrangement is symmetrical in position, but their meaning has not been traced. Cervical setae of the head is absent in all species of the family so far known.

7. Th. II: Anterior margin of mesothorax is beset with setae in one or some rows. Their specific difference was already mentioned in Christiansen 1957 in Lebanese species. In *Cyphoderus* spp., the marginal setae are all small, smooth, while in *Serroderus* spp., there is a pair of long setae on the median dorsum of it. In *"C. serratus"* of Vietnam and French Guiana, the margin is adorned with many long, blunt setae, just as in case of *C. spinatus* Christiansen (1. c. Fig. 8).

8. Ventral Tube: Chaetal pattern is quite interesting. The simplest type may be found in *C. albinus*-group (Fig. 1 H, I), by which the anterior side is only with 2 + 2 long setae and posterior side is with 2 distal smooth, one proximal median and 2 + 2 lateral setae plus

2 + 2 pegs. All these setae may be either smooth or barbed after the species. In other type, the smooth distal setae are 4 in number and there may or may not be a pair of intermittent setae between them and a proximal median seta (Fig. 4 D). Setae of anterior side may be more in some species. The lateral flap is with 2 + 2 setae in *C. albinus* and up to 8 + 8 in some others.

9. Abd. VI: The segment is usually covered with many ciliated setae. But, there may exist one (*Mimoderus saikehi* Ys., 1980) or more number of smooth setae (Fig. 3 J) on it. The barbed setae may be also in a modified form (Fig. 6 C).

10. Chaetal pattern of Trunk: There are already data for the arrangement of macrosetae of the trunk in Christiansen 1957 and Yoshii 1980. But, it is still too early to deduce any conclusion from them. Further researches are needed.

As an overall conclusion, we are still in need to accumulate more detailed knowledge for each species, before we may establish the better taxonomic system of the family Cyphoderidae, to which, I hope, the present paper is to be a mile stone.

The preliminary key to the genera will be as:

1. Prelabrals smooth 2
   Prelabrals barbed ..... *Cyphoderodes* Silvestri
2. Tibiotarsus with smooth setae 3
   Tibiotarsus without smooth setae 4
3. Dens with few number of winged setae ..... *Paracyphoderus* Delamare,
   Dens with many poorly differentiated winged setae ..... *Mimoderus* Yoshii
4. Dens with dorsal row of setae ..... *Cyphoderus* Nicolet
   Dens without dorsal row of setae ..... *Serroderus* Delamare

Position of the following genera is uncertain:

Megacyphoderus Delamare: Possibly, the near relative of *Cyphoderus*.

Cephalophilus Delamare: Mandible and mucro almost absent.

Calobatinus Silvestri: Tibiotarsus with spathulate setae.

Cyphoderinus Denis: Mandible peculiarly deformed.

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Address of the author:
(Mr) Ryozo Yoshii, D. Sc. 吉井良三
Shokokuji-Monzen-cho 637-5, Kamikyo-ku, Kyoto, JAPAN 602 京都市上京区相国寺門前町 637-5